

CLAIMS

- 1 1. A consolidation process for single step manufacturing of a solid oxide fuel cell
2 (SOFC), said cell comprising a cathode, electrolyte, and anode, said consolidation
3 process comprising the steps of:

4 (a) assembling a layered structure of powdered materials representing sequentially
5 said cathode, electrolyte, and anode;

6 (b) selecting process parameters to yield a dense electrolyte and cathode and anode,
7 with controlled porosity; and

8 (c) consolidating the entire layered structure in a single step based on said selected
9 process parameters.
- 1 2. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 as per claim 1, wherein said process parameter of said electrolyte is selected to yield an
3 electrolyte density greater than 90% and a cathode/anode porosity level between 20-40%.
- 1 3. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 as per claim 1, wherein multiple SOFCs can be produced by consolidating a linear repeating
3 cell structure and associated separators.

- 1 4. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 as per claim 3, wherein said associated separators comprise thin boron nitride or alumina
3 discs.
- 1 5. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 as per claim 1, wherein said step of consolidating said layered structure in a single step is
3 done either via hot iso-static pressing or hot pressing.
- 1 6. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 as per claim 1, wherein said process further comprises the step of controlling
3 electrode/electrolyte interfacial area via a wavy die configuration.
- 1 7. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 as per claim 1, wherein said powdered materials are selected to yield SOFCs that can be
3 operated either at high temperature of about 1000⁰C or at a medium temperature between 600
4 to 700⁰C.
- 1 8. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 as per claim 1, wherein said consolidation step is performed at a temperature chosen within
3 the range of 900-1200⁰C.
- 1 9. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 as per claim 1, wherein said consolidation step is performed at a pressure chosen within the
3 range of 2000-5000 psi.

1 10. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 as per claim 1, wherein said anode/cathode further comprises any of the following pore
3 formers: carbon powder, carbon fibers, or corn starch.

1 11. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 as per claim 10, wherein said process additionally comprises the step of heating said
3 consolidated layered structure to burn out added pore formers.

1 12. A solid oxide fuel cell (SOFC) manufacturing system, said cell including at least a
2 cathode, electrolyte, and anode, said system comprising:

3 (a) a hot press, said press including heating and pressurization capabilities;

4 (b) a layered structure of powdered materials representing sequentially a cathode,
5 electrolyte, and anode, said layered structure received in said hot press;

6 (c) a die configuration; and

7 said solid oxide fuel cell created by hot pressing the entire layered structure in a
8 single step using said die configuration and selected heating and pressurization
9 parameters.

1 13. A solid oxide fuel cell (SOFC) manufacturing system, as per claim 12, wherein said
2 manufacturing system yields an electrolyte density greater than 90% and a cathode/anode
3 porosity level between 20-40%.

1 14. A solid oxide fuel cell (SOFC) manufacturing system, as per claim 12, wherein multiple
2 solid oxide fuel cells can be produced by hot pressing a linear repeating layered structure and
3 additional separators.

1 15. A solid oxide fuel cell (SOFC) manufacturing system, as per claim 14, wherein said
2 separators comprise thin boron nitride or alumina discs.

1 16. A solid oxide fuel cell (SOFC) manufacturing system, as per claim 12, wherein said hot
2 press is replaced by a hot iso-static process.

1 17. A solid oxide fuel cell (SOFC) manufacturing system, as per claim 12, wherein said die
2 configuration comprises a wavy die to control surface area.

1 18. A solid oxide fuel cell (SOFC) manufacturing system, as per claim 12, wherein said
2 powdered materials are selected to yield SOFCs that can be operated either at high
3 temperature of about 1000⁰C or at a medium temperature between 600 to 700⁰C.

1 19. A solid oxide fuel cell (SOFC) manufacturing system, as per claim 12, wherein said hot
2 pressing is performed at 900-1200⁰C.

1 20. A solid oxide fuel cell (SOFC) manufacturing system, as per claim 12, wherein said hot
2 pressing is performed at 2000-5000 psi.

1 21. A solid oxide fuel cell (SOFC) manufacturing system, as per claim 12, wherein said
2 anode or cathode further comprises any of the following pore formers: carbon powder, carbon
3 fibers, or corn starch.

1 22. A solid oxide fuel cell (SOFC) manufacturing system, as per claim 21, wherein said
2 system further comprises heating said hot pressed layered structure to burn out added pore
3 formers.

1 23. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 said cell comprising a cathode, electrolyte, and anode, said consolidation process comprising
3 the steps of:

4 (a) assembling a layered structure of powdered materials representing sequentially
5 said cathode, electrolyte, and anode, and

6 (b) hot pressing said layered structure in a single step to create a SOFC comprising a
7 highly dense electrolyte, a cathode, and a anode, whereby the density associated with
8 said electrolyte is greater than 90% and the porosity of said cathode and anode is
9 between 20-40%.

1 24. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 as per claim 23, wherein multiple SOFCs can be produced by hot pressing a linear repeating
3 layered structure and additional separators.

1 25. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 as per claim 23, wherein said powdered materials result in solid oxide fuel cells that can
3 operate at either high or medium temperatures.

1 26. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 as per claim 23, wherein said hot pressing is replaced by a hot iso-static pressing.

1 27. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 as per claim 23, wherein said electrolyte comprises a substantially non-interconnected
3 porosity and said anode and cathode have at least partially interconnected porosity.

1 28. A consolidation process for single step manufacturing of a solid oxide fuel cell (SOFC),
2 as per claim 23, wherein interconnects are additionally pressed into said layer structure
3 during hot pressing.